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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/483,881	01/18/2000	Kie Y Ahn	303.672US1	8976

21186 7590 06/09/2004

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EXAMINER	
NGUYEN, HA T	

ART UNIT	PAPER NUMBER
2812	

DATE MAILED: 06/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Acti n Summary	Application No.	Applicant(s)	
	09/483,881	AHN ET AL.	
	Examiner	Art Unit	
	Ha T. Nguyen	2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 April 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *3,5,7-42 and 65* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *3,5,7-42 and 65* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *12-10-3&4-26-4*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Notice to applicant

1. Applicants' Amendment and Response to the Office Action mailed 12-23-3 has been entered and made of record .

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103© and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 3, 5, 7-42 and 65 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al. (USPN 6372622, hereinafter "Tan") in view of Matsuda et al. (USPN 6403481, hereinafter "Matsuda").

[Re claims 7 and 65] Referring to Figs. 2-6 and related text, Tan discloses a method for forming copper vias on a substrate, comprising: depositing a seed layer including a thin film of Palladium (Pd) or Copper (Cu) on a semiconductor substrate 10 (see col. 3, lines 30-53); using a photolithography technique in order to define a first number of via holes above the seed layer (see Fig. 2); and depositing a layer of copper over the seed layer (see par. bridging cols. 3 and 4); and removing the photoresist layer (see col. 5, lines 1-5). But it does not disclose expressly using electroless plating to form the copper layer, the thickness and the discontinuity of the seed layer;

and removing the photoresist layer using oxygen plasma ashing. However, the missing limitations are well known in the art because Matsuda discloses the use of Cu electroless plating on discontinuous seed layer and the thickness of seed layer (see Figs. 1-7B, Summary and col. 6, line 55- col. 7, line 24). The combined teaching of Tan and Matsuda does not disclose oxygen plasma ashing of the photoresist. However, the examiner takes Official Notice that plasma ashing is a conventional method of removing photoresist. A person of ordinary skill is motivated to modify Tan with Matsuda to use electroless plating to deposit Cu to obtain good electromigration resistance (see Matsuda, col. 2, lines 11-22).

[Re claim 13] The combined teaching of Tan and Matsuda discloses substantially the limitations of claim 13, as shown above. It also discloses the forming of a second patterned photoresist defining a number of line openings above the copper vias. But it does not disclose expressly the repetition of the steps in the forming of the vias to form conductive lines. However, the transposition of process steps or the splitting of one steps into two, where the processes are substantially identical or equivalent in terms of function, manner and result was held not to patentably distinguish the processes (Ex Parte Rubin, 128 USPQ 440 (Board of Appeals 1959).

[Re claims 3 and 17] Tan also discloses wherein depositing a seed layer includes depositing a seed layer using a physical vapor deposition process (see col. 3, lines 40-53).

[Re claims 8, 9, 12, and 14] The arguments used for the rejection of claims 7 and 3 apply.

[Re claims 5, 10,11, and 16] Tan also discloses wherein depositing a layer of copper includes filling the number of via holes substantially to a top surface of the photoresist layer or forming a number of copper vias, wherein the copper vias are formed on the seed layer but not on the patterned photoresist layer (see Fig. 3).

[Re claim 18] The combined teaching of Tan and Matsuda discloses substantially the limitations of claim 18. But it does not discloses that the thickness of the second patterned photoresist is less than that a thickness of the first patterned photoresist layer. However, it is within the level of skill of a person of ordinary skill in the art to deposit the second patterned photoresist layer to a thickness suitable for the desired purpose, including less than a thickness of the first patterned photoresist layer.

[Re claim 19] Tan discloses wherein depositing the second patterned photoresist layer which defines a second number of line openings includes a number of first level line openings (see Fig. 4.

[Re claims 20, 21, and 28] The combined teaching of Tan and Matsuda discloses substantially the limitations of claims 20, 21, and 28, as shown above. But it does not discloses expressly forming second and third seed layers, second and third patterned photoresist layer, first level of conductor lines, the second level copper vias. However, the argument concerning the repetition of steps used for the rejection of claim 13 applies.

[Re claims 15 and 29] The combined teaching of Tan and Matsuda discloses substantially the limitations of claims 15 and 29. But it does not discloses that the first seed layer is deposited by evaporation. However, the examiner takes Official Notice that this feature is well known in the art.

[Re claims 22 and 23] The argument used for the rejection of claims 13 and 14 concerning the claimed feature apply.

[Re claims 24-27] The arguments used for the rejection of claims 10, 7, 3, and 18 respectively apply.

[Re claims 31-33] The arguments used for the rejection of claims 14, 3, and 7 concerning the respectively claimed features apply.

[Re claim 34] The arguments used for the rejection of claims 7, 20, and 21 apply. Besides, it would have been obvious for a person of ordinary skill in the art to use the same seed material to form all the needed seed layers to simplify the manufacturing process.

[Re claims 35-37] The arguments used for the rejection of claims 22, 3, and 7 respectively, for the related claimed features, apply .

[Re claims 30, 38, and 39]] The combined teaching of Tan and Matsuda discloses substantially the limitations of claims 30, 38, and 39, as shown above. It also disclose removing the seed layer (see col. 5, lines 1-5). But it does not disclose expressly the removal of photoresist layers includes removing the first, second, and third seed layers. However, it would have been obvious for a person of ordinary skill in the art to do so in the photoresist overetching step since the seed layers contacting the resist layer is thin, to ensure clean multilevel interconnect structure is obtained.

[Re claims 40-42] Tan discloses the use of a diffusion barrier layer under a copper contact (see col. 3, lines 40-53). When repeating the steps of forming contacts (vias or wiring lines), the barrier layer of the subsequent level (vias or wiring lines) is formed on the previously formed level. But it does not disclose the use of a diffusion barrier on the second level of copper lines and the claimed material. However, the examiner takes Official Notice that, these features are well known in the art, they are intended to effectively prevent Cu diffusion to the surrounding environment (see Ashley and Simpson).

Therefore, it would have been obvious to combine Tan and Matsuda to obtain the invention as specified in claims 3, 5, 7-42, and 65.

4. Claims 13-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan in view of Matsuda and Simpson (U.S. Patent 6197688).

The combined teaching of Tan and Matsuda discloses substantially the limitations of claims 13-42, as shown above. It also discloses the forming of a second patterned photoresist defining a number of line openings above the copper vias. But it does not disclose expressly the repetition of the steps in the forming of the vias to form conductive lines. However, the missing limitation is well known in the art because Simpson discloses that separately forming conductive vias then repeating the steps to form conductive lines are conventional in the art (See fig. 9). Therefore, it would have been obvious to combine Tan and Matsuda with Simpson to obtain the invention as specified in claims 13-42.

Response to Amendment

5. In view of the Applicants' amendment to the claims, the objection to claims 10, 11, and 16, for informalities, has been withdrawn.

Applicants' arguments with regard to the rejections under 35 U.S.C. 102 or 103 have been fully considered, but they are not deemed to be persuasive for at least the following reasons.

Applicants appeared to argue mainly that none of the applied references teaches the formation of a seed layer including a thin film of Pd or Cu on a semiconductor substrate. The examiner disagreed, Tan clearly discloses a seed layer of Cu sputtered over a barrier layer 14 which is itself formed on a semiconductor substrate 10 (see col. 3, lines 30-53).

Therefore the combined teaching of Tan and Matsuda or Tan, Matsuda and Simpson does disclose all the limitations of the rejected claims 3, 5, 7-42 and 65.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for response to this final action is set to expire THREE MONTHS from the date of this action. In the event a first response is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for response expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ha Nguyen whose telephone number is (571) 272-1678. The examiner can normally be reached on Monday-Friday from 8:30AM to 6:00PM, except the first Friday of each bi-week. The telephone number for Wednesday is (703) 560-0528.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Neibling, can be reached on (571) 272-1679. The fax phone number for this Group is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

Ha Nguyen
Primary Examiner
06-7 - 04